PICASSO: In-situ Airborne and Multi-frequency Radar Observations of Ice Clouds over the UK

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INTRODUCTION

PICASSO (Parameterizing Ice Clouds using Airborne obServationS and triple-frequency dOppler radar) will collect a new dataset of ice cloud properties using state of the art ground-based radars and airborne in-situ instrumentation. The dataset will be used to develop new algorithms to allow improved radar retrievals of ice cloud properties, including estimates of uncertainties, and to critically evaluate existing operational radar retrievals used on ground-based and spaceborne platforms.

In-situ observations will be obtained from the UK FAAM **BAE146** research aircraft. The aircraft will have a suite of particle detectors and imagers installed.

Triple frequency radar observations will be obtained from the CFARR ground site at Chilbolton, in the southern UK.

DATA COLLECTION

- **PICASSO missions take place in Jan-Feb and April 2018.**
- **Approximately 15 aircraft missions will be executed in the vicinity of the CFARR ground site.**
- **In-situ observations will be closely coordinated with synchronised triple frequency dual polarisation Doppler radar RHI and PPI scans to develop new retrieval methods.**
- **We will target large scale ice clouds associated with frontal systems to study nucleation, PSDs, and particle density.**
- **We will target GPM-Core underpasses when possible.**

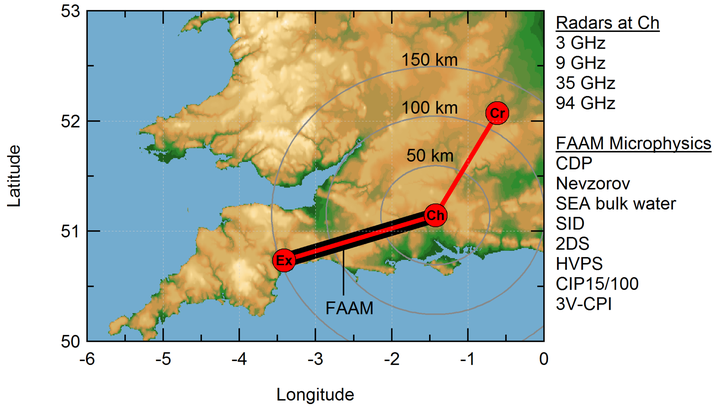

Figure 1: The PICASSO operating area. The FAAM aircraft will fly along radials to the WSW of the CFARR ground site.

Instrument	Measured parameter	Operator
PCASP	Aerosol Size Distribution (0.1-3 µm)	FAAM
Cloud Droplet Probe (CDP)	Cloud Droplet Distribution (1-50 µm)	FAAM
CIP-15	Particle Size Distribution (0.1-0.8 mm)	FAAM/Manchester
2DS	Particle Size Distribution (0.05-1.2 mm)	Manchester
CIP-100	Particle Size Distribution (1-6 mm)	FAAM
HVPS3	Particle Size Distribution (1-20 mm)	Manchester*
3VCPI	Particle Imagery (0.02-1 mm)	Manchester
HALOHOLO	Particle holography (0.01 – 5mm)	Manchester/Mainz
SID-2	Particle Size Distribution (1-40 µm)	Met Office
ISMAR	mm- and sub-mm radiometer	Met Office
Nevzorov	Liquid and Ice Water Content	FAAM/Met Office
WCM-2000	Liquid and Ice Water Content	FAAM/Met Office

Table 1: An overview of the cloud particle detectors and imagers which will be operated on the FAAM aircraft during PICASSO missions.

EXAMPLE IN-SITU DATA

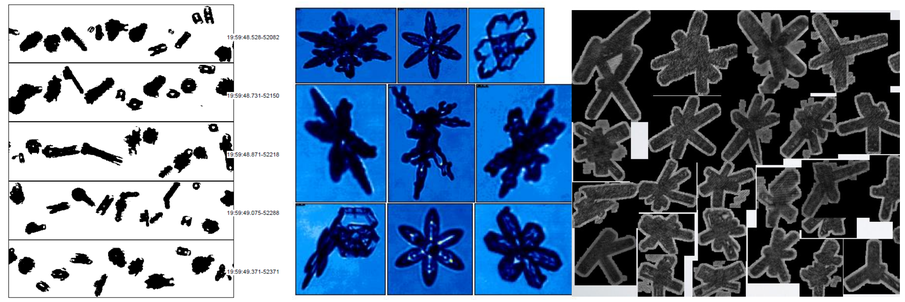

Figure 2: A variety of technologies will be utilised on the BAE146, including high speed Optical Array Probes (OAPs, such as the 2DS shown on the left), 8-bit greyscale imagery using a CCD (CPI, as shown in the middle), and holographic imaging (HALO-HOLO, as shown on the right).

PREVIOUS IN-SITU/RADAR STUDIES AT CFARR

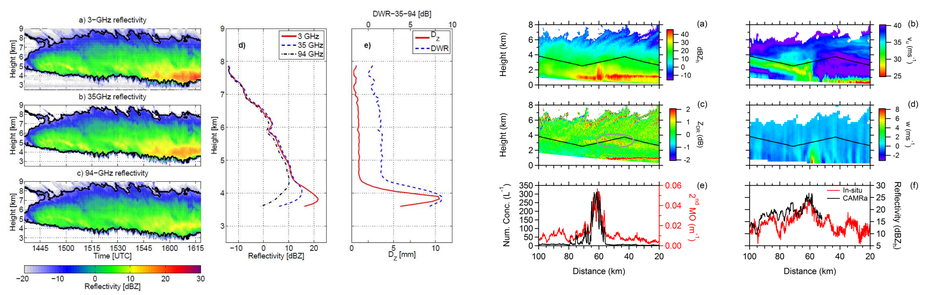

Figure 2: Previous triple frequency radar studies have been conducted at Chilbolton, as discussed by Stein et al (2015) and shown to the left. In-situ observations have been previously conducted over Chilbolton(Crosier et al, 2014), as shown on the right (aircraft flight track is indicated by the black line).

REFERENCES

Stein THM, CD Westbrook, and JC Nicol. Fractal geometry of aggregate snowflakes revealed by triple-wavelength radar measurements. Geophys. Res. Lett. 42 176-183 (2015)

Crosier, J. et al. Microphysical properties of cold frontal rainbands. Q. J. R. Meteorol. Soc. 140, 1257–1268 (2014).